

Research on the Impact of Digital Economy on Urban Green and High Quality Development under the "Dual Carbon" Goal

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Abstract

As an emerging economic form, the digital economy is dominated by data resources, mainly based on modern information networks, with the continuous integration and application of information and communication technology under the actual conditions, digitalization has crossed the primary stage, and the transformation has entered the "all-factor" stage, and the digital economy has also continued to progress and develop, and has made new achievements in the field of promoting fairness and efficiency. In September 2020, at the 75th session of the United Nations General Assembly, China officially proposed the "dual carbon strategy", that is, to achieve the goal of carbon peak by 2030 and carbon neutrality by 2060. The "dual carbon" strategy requires us to advocate and adopt green, environmentally friendly, low-carbon, and resource-saving production and lifestyle, reduce carbon emissions, build a green "digital economy", and promote the green and high-quality development of cities. Contribute to the reduction of global carbon emissions. Digital economy empowering urban development is a hot topic in today's society, which has achieved remarkable results in promoting enterprise transformation and green development, and is conducive to accelerating the realization of the strategic goal of carbon peak and carbon neutrality. Based on the research results of scholars at home and abroad, this project first conducts a theoretical analysis of the digital economy to reduce energy consumption and carbon emissions. Secondly, the current situation of the digital economy and the green and high-quality development of Chinese cities were investigated and statistically analyzed. Finally, the conclusions and policy suggestions for the development of digital economy and green economy are concluded. At the same time, in view of the research results of academic papers at home and abroad, this project integrates theory and practice to analyze the impact of digital economy on the green and high-quality development of cities under the background of "dual carbon", and puts forward relevant suggestions according to the current situation reflected in the research.

Keywords

Digital economy; Carbon emission reduction; Green and high-quality development; Energy consumption.

1. Introduction

Carbon dioxide is one of the main greenhouse gases, and its emissions are one of the main causes of global warming. According to the BP World Energy Statistical Yearbook 2022, from

1978 to 2021, China's total primary energy consumption increased from 16.65 EJ to 157.65 EJ, and its proportion in the world's total primary energy consumption increased from 6.11% to 26.5%. China's energy carbon emissions have grown rapidly from 1.419 billion to 10.523 billion tons. At the same time, the international community has also generally recognized the need to take positive actions to reduce greenhouse gas emissions, and in this context, many countries and regions have supported the promotion and implementation of the "dual carbon" goal. The "dual carbon" goal refers to the dual goals of achieving carbon peak and carbon neutrality. Carbon peak means that a country's or region's carbon dioxide emissions begin to gradually decrease after reaching a peak, while carbon neutrality refers to a balance between a country's or region's carbon dioxide emissions and carbon dioxide absorption, that is, emission reductions are equal to absorption. The 2021 government work report of the State Council pointed out that it is necessary to do a solid job in carbon peak and carbon neutrality, formulate an action plan for carbon emission peak before 2030, and optimize the industrial structure and energy structure. Efficiently achieving the "dual carbon" goal is the only way to respond to climate change, promote sustainable development, industrial transformation and upgrading, enhance energy security, and strengthen international cooperation.

As an important driving force and innovation force for China's high-quality economic growth, the digital economy has become increasingly prominent in its position and role in social and economic development, and is considered to be the focus and key point for realizing China's industrial transformation and upgrading, and the transformation of old and new kinetic energy. In recent years, China's digital economy has been booming, and the scale of various industries has continued to grow rapidly, ranking second in the world for several years. Data show that from 2012 to 2021, the scale of China's digital economy has grown from 11 trillion yuan to more than 45 trillion yuan, and the proportion of digital economy in GDP has increased rapidly from 21.6% to 39.8%. It is worth noting that due to its special environment-friendly characteristics, the innovation of digital technology in the economic field triggered by the digital economy has accelerated the transformation and innovation of traditional backward production capacity, which coincides with the requirements of today's green development. Therefore, it is of great significance to explore the development of the digital economy for the green and high-quality development of cities, especially under the "dual carbon" goal.

2. Literature Review

From a practical point of view, the digital economy is becoming a new driving force for economic transformation and upgrading and green and low-carbon development. On the one hand, digital technology has brought about changes in urban production factors and promoted the adjustment and optimization of industrial structure. On the other hand, digital technologies help to improve product quality, reduce energy consumption, etc. From an academic point of view, the digital economy, as the core of informatization and digital policy development strategy, has been widely studied and discussed by scholars at home and abroad.

Specifically, the relationship between the digital economy and carbon emissions, Sun Wenyuan and Zhou Haoping (2022) found that local government competition plays an important role in the impact of the digital economy on carbon emissions, and in the competition of local governments, the digital economy indirectly becomes an important way to curb carbon emissions as a tool. Ren Xiaosong (2022) proposed that the digital economy, as an emerging economic form, is not only conducive to improving local industrial carbon productivity (carbon productivity refers to the ratio between industrial production and corresponding carbon emissions or greenhouse gas emissions), but also has a similar effect on neighboring cities. In the future, we should pay attention to the use of digital technology to break through intercity restrictions and promote the coordinated development of a region. Guo Feng and Yang

Shangguang (2022) proposed that the development of digital economy is conducive to innovation in the field of technology, and promotes the construction of green cities through technological innovation. Xiang Yu and Zheng Jing (2023) believe that the carbon emission reduction effect of the digital economy is more obvious in non-resource-based cities, eastern regions and low-emission cities, and the carbon emission reduction effect of the digital economy is also affected by the level of urbanization, showing a threshold effect. Wang et al. (2001) pointed out that although the development of the information industry can indeed improve the intensive use of resources and reduce environmental pollution, the development and optimization of communication technology is based on the premise of high energy consumption, so it increases the waste of resources. In summary, there are a lot of studies on the environmental effects of Internet development, but most of these studies focus on comprehensive indicators such as industrial waste and green development, and so far few studies have analyzed the impact of digital economy on regional carbon emission levels, and its mechanism also lacks rigorous theoretical elaboration.

Based on the research of the literature, this paper has a far-reaching practical impact on optimizing the development of the digital economy and promoting low-carbon emission reduction in cities, and provides a new direction for achieving the dual carbon goals and promoting the green and high-quality development of cities.

3. Theoretical Analysis

3.1. Digital economy and energy consumption

As an emerging economic form, the digital economy is dominated by data resources, mainly based on modern information networks, with the continuous integration and application of information and communication technology under the actual conditions, digitalization has crossed the primary stage, and the transformation has entered the "all-factor" stage, and the digital economy has also continued to progress and develop, and has made new achievements in the field of promoting fairness and efficiency.

Digital technology is an important part of modern information technology, which provides people with more accurate, efficient and convenient services by collecting, processing and analyzing large amounts of data. In the field of energy consumption, the application of digital technology can play an important role in optimizing the energy consumption structure, improving energy efficiency, reducing energy consumption and carbon emissions, and promoting the development of clean energy. In terms of production methods, the development of the digital economy optimizes the production process and promotes all aspects of production, distribution, circulation and consumption through data flow

efficiency and thus reduce energy consumption. [1] With the continuous development of the digital economy, the traditional energy consumption structure can no longer meet the development and innovation needs of modern society. The rapid development of the digital economy has also promoted the development of clean energy, making the energy consumption structure more diversified, improving energy efficiency, and reducing energy consumption and carbon emissions. In addition, the development of the digital economy has also promoted the digital transformation of energy, making the energy industry more intelligent and efficient. On the one hand, the application of digital technology can realize the intelligent production and consumption of energy, and improve energy efficiency. On the other hand, digital transformation can promote the upgrading and transformation of industries, so as to optimize the industrial structure and reduce energy consumption and carbon emissions. In addition, digitalization can also promote the promotion and application of energy-saving and emission-reduction technologies, and improve the efficiency and safety of energy-saving and emission-reduction.

As an important part of economic development, energy consumption also plays an important feedback role in the development of the digital economy. On the one hand, the optimization of energy consumption structure and the development of clean energy can provide a more environmentally friendly and sustainable energy guarantee for the development of the digital economy. On the other hand, the improvement of energy efficiency and the promotion of energy-saving and emission reduction technologies have provided a more stable and reliable infrastructure for the development of the digital economy. With the continuous development of the digital economy, the structure of energy consumption has also undergone significant changes. The traditional energy consumption structure has been gradually replaced by clean energy, and the proportion of clean energy consumption such as solar and wind energy is increasing, which is not only conducive to environmental protection and sustainable development, but also provides a cleaner and more sustainable energy guarantee for the development of the digital economy. With the advancement of science and technology and the development of society, the future development trend of digital economy and energy consumption will be more closely linked. On the one hand, digitalization will continue to penetrate into all areas of energy consumption in the future to achieve more intelligent and efficient management. On the other hand, the digital economy and clean energy will also be more closely integrated, promoting cleaner and more sustainable development. At the same time, digitalization will also promote the development and improvement of the carbon trading market, and promote the realization of a more equitable and effective allocation of carbon emission resources.

However, due to the marginal diminishing effect of digital resources as an input factor and the rebound effect of energy consumption, there may be a nonlinear relationship between the development of digital economy and energy consumption. In the early stage of the steady development of the digital economy, the digital economy has a large marginal effect on energy consumption and savings due to its unique role in industrial digitalization and the multifaceted impact of digital technology, and the impact of energy consumption on the digital economy in all aspects has been significantly reduced. In the middle of the development of the digital economy, the marginal effect of the digital economy on energy conservation gradually declined, and its effect on reducing the level of energy consumption reached its peak. When the digital economy reaches the mature stage, the marginal effect of the digital economy on energy conservation is negative.

3.2. Digital economy and carbon emissions

The digital economy itself is environmentally friendly and is a low-carbon economy, which promotes the reduction of energy consumption and carbon emissions through the digital transformation of industries and the transformation of energy consumption structure. This is because energy consumption has a significant positive impact on carbon emissions, and the impact of the digital economy on energy consumption can be directly transmitted to carbon emission reduction. At the same time, the digital economy itself is centered on cloud computing, big data, industrial Internet, blockchain, etc., with "low energy consumption, high output, and high return" as its main characteristics, so the development of the digital economy is conducive to promoting carbon dioxide emission reduction.

In terms of production, the digital economy can reduce carbon emissions by optimizing resource allocation, improving production efficiency, and reducing energy consumption. For example, the digitized production process can achieve intelligent management and refined control, reduce energy waste and waste generation, and thus reduce carbon emissions. At the same time, the digital economy can also promote the research and development and application of energy-saving and emission reduction technologies, promote the use of clean energy, and further reduce carbon emissions. The digital economy can facilitate the green transformation

of businesses and industries. Through digital technology, companies can better monitor and manage environmental impacts, and achieve efficient use and recycling of resources. At the same time, the digital economy can also promote the development of emerging green industries, such as renewable energy, energy-saving and environmental protection technologies, to further reduce carbon emissions.

In terms of life, the digital economy can change the way people travel and promote low-carbon transportation. For example, the development of sharing economy models, such as bike-sharing, car-sharing, etc., can reduce the use of personal cars, reduce traffic congestion and carbon emissions. At the same time, digital technology can also provide travel information and intelligent navigation, optimize traffic flow, reduce energy waste and environmental pollution. The digital economy can promote the development of green consumption. Through digital technology, consumers can more easily access the environmental information and energy consumption of products, and choose more environmentally friendly and low-carbon products. At the same time, the digital economy can also promote the establishment of green supply chains and reduce carbon emissions from the transportation and packaging of goods.

4. Analysis of the Current Situation

4.1. The level of development of the digital economy

Digital economy refers to the economic activities that are based on digital technology and carry out the production, circulation and consumption of information through the Internet, big data, artificial intelligence and other technical means. According to relevant data, China's digital economy is developing rapidly. The Digital China Development Report (2022) pointed out that in 2022, the scale of China's digital economy has reached 50.2 trillion yuan, ranking second in the world, accounting for 41.5% of GDP, and the digital economy has become an important engine for stable growth and transformation. At the same time, the report shows that the scale and energy level of China's digital infrastructure have increased significantly. By the end of 2022, 2.312 million 5G base stations had been opened, and 561 million 5G users had been opened, accounting for more than 60% of the global total. The number of mobile Internet of Things end users reached 1.845 billion, becoming the first country among the world's major economies to achieve "superhuman things", and China's data resource system has also accelerated its construction, with data output reaching 8.1ZB in 2022, a year-on-year increase of 22.7%, accounting for 10.5% of the global total, ranking second in the world.

At the same time, the scale of the digital economy is expanding globally. According to data from international organizations and institutions, the global digital economy has exceeded \$10 trillion in output value and continues to grow. There are more than 5 billion Internet users in the world, most of whom access the Internet through mobile devices. Applications in the digital economy, such as mobile payments, e-commerce, online education, and telecommuting, are changing people's lifestyles and business models. The development and application of technologies such as networking, artificial intelligence, big data, cloud computing, and the Internet of Things. At the same time, the digital economy has given rise to new industries and jobs. With the development of the digital economy, emerging industries such as Internet finance, sharing economy, and e-commerce have risen rapidly and become an important driving force for economic growth. At the same time, the development of the digital economy has also created a large number of job opportunities, especially in areas such as technology, data analytics, and digital marketing. The rise of e-commerce has promoted the transformation of the traditional economy to online, promoted the efficient flow of resources and information, and reduced resource consumption and carbon emissions.

4.2. The level of green and high-quality development of the city

First of all, China is currently vigorously promoting urban greening, so that the city can reproduce green waters and green mountains. In order to improve the quality of the environment and the living conditions, local governments have intensified greening efforts and built a large number of urban green spaces such as parks, green belts, and green squares. This not only improves the ecology of the city, but also provides more leisure and entertainment places for urban residents, increasing the livability and attractiveness of the city. According to the white paper "China's Green Development in the New Era", from 2012 to 2021, the green coverage rate of urban built-up areas increased from 39.22% to 42.06%, and the per capita park green space area increased from 11.8 square meters to 14.78 square meters. Second, Chinese cities have also made great strides in building green transportation systems. The government has increased investment in public transport, optimized public transport routes, improved the quality of public transport services, and encouraged residents to use less private cars and more by subway, bus, bicycle or walk. Doing so reduces greenhouse gas emissions from the transportation sector and also reduces traffic congestion in the city. Since 2012, more than 30 million yellow-labeled vehicles and old vehicles have been eliminated, and 47,100 inland waterway vessels have been dismantled and renovated. 51 cities have opened and operated 275 urban rail transit lines, with an operating mileage of more than 8,700 kilometers; The number of bus-only lanes increased from 5,256 km in 2012 to 18,264 km in 2021.

Finally, green lifestyles are becoming fashionable, which is also an important symbol of the green development of Chinese cities. More and more residents are beginning to pay attention to environmental protection and low-carbon life, and reduce excessive consumption and waste of resources. More green products and sustainable lifestyles have emerged in the market, such as solar photovoltaics, garbage sorting, plant-based diets, etc. These changes have gradually been popularized in both urban and rural areas, providing strong support for the green and high-quality development of cities. 109 cities participated in the creation of green travel with high quality. In cities above the prefecture level, the classification of domestic waste has been widely carried out, and the habit of active classification of residents has gradually formed.

Overall, Chinese cities have made great strides in green and high-quality development. Remarkable results have been achieved in vigorously promoting urban greening, building a green transportation system, regional joint prevention and control, and coping with heavily polluted weather, and green lifestyles are gradually becoming fashionable. We have reason to believe that in the near future, the green development of Chinese cities will achieve more significant results, and let our cities reproduce the beautiful scene of clear waters and lush mountains.

5. Conclusions and Recommendations

Digital technology with the digital economy at its core has profoundly changed the way of life and production of human beings [2], not only promoting the transformation and upgrading of urban industrial structure, but also promoting the sustainable development of urban economy and environment. The digital economy affects carbon emission reduction through the level of technological progress that affects carbon emissions. This paper analyzes the impact of the development of the digital economy on urban carbon emissions and green and high-quality development under the dual carbon goals, and the results show that the digital economy has a significant role in promoting urban carbon emissions, and the impact of different regions is heterogeneous. In view of this conclusion, countermeasures and suggestions for promoting high-quality urban development under the dual carbon goal of digital economy are proposed.

5.1. Accelerate innovation in digital technology

As far as the high-quality development of a city is concerned, in order to give full play to the role and advantages of the digital economy in the new technological revolution and industrial transformation, it is necessary to break through the limitations and routines of traditional thinking and methods, and avoid blindly fighting for money, talents, and policies. Only with the continuous development and innovation of digital technology can more digital products and infrastructure be used, carbon emissions can be continuously reduced, and the digital economy can play a greater role in the process of high-quality urban development. For example, for the "digital infrastructure", which involves high-tech and special fields, the government should do a good job in overall planning and play a leading role, and the enthusiasm of market entities should be fully enhanced, and the participation of market entities should be improved.

5.2. Optimization and upgrading of industrial structure

The digital economy can promote the optimization and upgrading of the industrial structure in two aspects. On the one hand, digital industrialization, that is, the development of the digital technology industry with information and communication technology as the core, provides infrastructure, platform services, big data, massive resources and other support for other industries, helps the development of emerging industries and high-tech industries, and improves the level of industrial structure upgrading.

On the other hand, industrial digitalization is the integration of traditional industries with digital technology to form new low-energy-consuming industries, reduce costs, reduce pollution, optimize product quality, and innovate business models, presenting a more reasonable industrial structure. Through the above two aspects, the digital economy promotes carbon emission reduction under the dual carbon goals, and innovates and empowers traditional industries, so as to promote the high-quality and sustainable development of cities.

5.3. High-quality development of the digital economy

The high-quality development of the digital economy is conducive to promoting digital transformation and the green and innovative development of cities. First of all, the development of digital operations should be promoted in all fields, so as to improve the digital management capabilities of cities and promote the efficient and integrated development of urban digital operations and the real economy [3]. With the emergence and popularity of network and digital technologies, enterprises need to accelerate the transformation to digitalization to adapt to the new needs of the market and realize enterprise transformation, and gradually transform digital technology into an energy power to help enterprises operate in a low-carbon and environmentally friendly manner. From the perspective of local policies, the government must pay more and more attention to the effect of the digital economy in the development of green innovation and the upgrading of industrial structure. At the same time, local governments must strengthen the innovation and development of the digital economy, actively guide local small and medium-sized enterprises to innovate the industrial structure, use new technologies to develop the pollution reduction effect of enterprises, and promote the green and sustainable development of local enterprises and cities while promoting economic growth [4].

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